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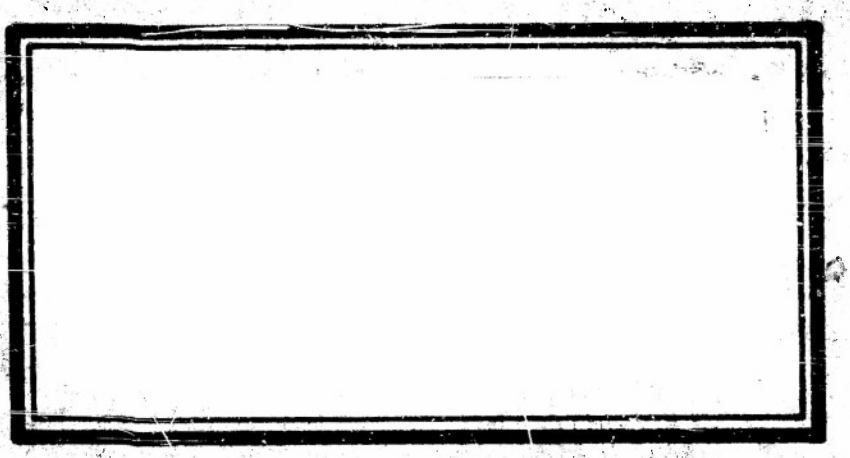

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W. A. Nierenberg
Director

Technical Report No. 28

Results of Preliminary Experiments on Well Listening on Fire Island

by

M. V. Brown and F. Evans

Research Sponsored by
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August 10, 1954

This report consists of 9 pages

TABLE OF CONTENTS

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LIST OF FIGURES

RESULTS OF PRELIMINARY EXPERIMENTS ON WELL LISTENING ON FIRE ISLAND

by

M. V. Brown and F. Evans

I. INTRODUCTION

This is the second report (1) relating to a new method of submarine detection. Existing techniques employing two-dimensional arrays of hydrophones are envisaged. The new contribution is the utilization of deep wells drilled on dry land for hydrophone locations.

A preliminary test of the effectiveness of sound reception in a well (1) was made at the U.S. Navy Mine Countermeasures Station, Panama City, Florida. The obvious next step was to choose a location where the geology might not be unfavorable and which would be of more importance in guarding sea lanes. Preliminary tests were required in a short time to prove that in a general way such a location would give positive results. Therefore, further tests were made during the period August 17-18, 1954, using a well on Great South Beach (popularly known as Fire Island) belonging to the Bellport Lifeboat Station, C.G. No. 79. This well was only 380 ft deep, which is undoubtedly too shallow for optimum listening. However, the results were even more encouraging than those at Panama City. It appears that a much wider range of frequencies was transmitted at Fire Island than was observed at Panama City.

This may be due either to a difference in the geology of the area or to a lesser high frequency ambient noise at Fire Island. Neither set of observations was complete enough to be definitive.

The primary purpose of the Fire Island experiment was to observe the ambient noise level. However, since the opportunity offered, a few small charges of TNT were exploded offshore and recorded at the well. For the purposes of understanding the results, an extrapolation of the range run (6.5 mi) was made. It indicated that a 1 lb charge should be heard to a distance of the order of 400 miles if there are no serious faults or changes in the stratification of the rocks making up the ocean bottom. The continental shelf extends from shore approximately 100 miles at this point.

During the period August 17-18, the broad band (3-1000 cps) ambient noise was 24 db above 1 dyne per square cm. The surf was low. Further observations are needed to determine how ambient noise depends upon surf.

Local sources contribute greatly to the ambient level. Even when the hydrophone was 350 ft deep, automobiles 100 ft away and even footsteps near the well were easily distinguished. The program outlined in the earlier report supposed the employment of vertical arrays. This will be unquestionably important in reducing the effect of the surface noise. A second row of wells can be employed to reduce the backward noise.

The upper 1400 ft of the geological column at Panama City is separated acoustically into four layers. Present information about the Fire Island area indicates that the upper 1700 ft contains only one or two acoustically different layers to a distance of 20 miles offshore (2,3). Oliver and Drake report two layers, while Ewing, et al. report only one with a second appearing about 15 miles offshore. The speeds of sound in this intermediate layer as reported by Oliver and by Ewing differ markedly, 6500 ft/sec and 11,800 ft/sec, respectively. The Oliver section was near Shinnecock Inlet, while that of Ewing was near Fire Island Inlet. The Bellport Lifeboat Station is in between, therefore conditions in this area are indeterminate.

II. MEASUREMENTS

On August 17, the hydrophone was placed at depths from 50 to 350 ft. At each depth, several bandwidths were used and the average ambient noise voltage was read off a battery operated vacuum tube voltmeter. In addition, the signal was monitored with earphones to establish the absence of obvious circuit noises. The data obtained are tabulated in Fig. 1. It is apparent that there are no large changes in noise amplitude with depth changes. However, there is a definite increase as the low frequency end of the band-pass filter is extended. For the shot work on August 18, new readings of ambient noise were taken at several depths for the band 3-1000 cps. These are shown in parentheses in Fig. 1.

On August 18, a range run was made in which our buoy boat traveled a course at 160° extending from a point 50 yards offshore to a point 6 1/2 mi at sea. The hydrophone was placed 350 ft down in the well. Caps were fired for the first mile and were received quite clearly, particularly the components above 100 cps.

As the run extended out from the 1 mile point, 1/2 lb, and, later, 1 lb charges were fired. For the heavier charges and greater ranges, the lower frequencies (less than 100 cps predominated). The return run was a repetition of the initial run except that the hydrophone was placed at 200 ft. Sound pressures were recorded on a Brush oscillograph recorder. The peak-to-peak sound pressures as a function of distance are shown in Fig. 2. A "best" straight line was fitted to the data and is shown in comparison to the ambient noise level in the well. The two lines are projected to a point where the amplitudes are equal. This distance is about 400 miles.

The location of the Bellport Lifeboat Station is 72°55'45" W by 40°42'45" N. On both days, the sea was about state 1 and the surf was slight with only one line of about 1-2 ft breakers. The ambient noise levels may have been somewhat high because of a small leak (1 quart per hour) in the relief valve of the well.

The well is of the artesian type. There was a capped static pressure of 6 psi. Therefore, a pressure lock was constructed for inserting the hydrophone.

III. FUTURE PROGRAM

The program outlined in the earlier report will now be prosecuted vigorously on the south shore of Long Island. Simultaneously, several sites will be explored for suitability and deeper wells will be dug. Besides this outline, two complete experimental programs will be undertaken to measure phase variations and transmission as a function of frequency using explosive and CW techniques. It is anticipated that the optimum reception frequency will be lower than that generally employed at present in long distance submarine detection. The geology will be more carefully evaluated experimentally. More permanent control of the stations in Long Island will have to be obtained for security purposes.

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FIG. 1

AMBIENT NOISE LEVEL IN WELL AT BELLPORT LIFE BOAT STATION

AUG. 17, 1954

BANDWIDTH

DEPTH	3-1000 CPS	10-1000 CPS	30-1000 CPS	100-1000 CPS
50 FT.	(24)* +28 db wrt. 1 dyne/cm²	+24 db wrt. 1 dyne/cm²	+18 db wrt. 1 dyne/cm²	+14 db wrt. 1 dyne/cm²
100 FT.	(22)* 32 " " "	28 "	26 "	16 "
150 FT.	(26)* 24 "	22 "	16 "	12 "
200 FT.	(22)* 28 "	24 "	18 "	12 "
250 FT.	24 "	22 "	18 "	12 "
300 FT.	24 "	24 "	18 "	10 "
350 FT.	23 "	22 "	21 "	16 "

* READING IN PARENTHESIS OBTAINED AUG. 18, 1954

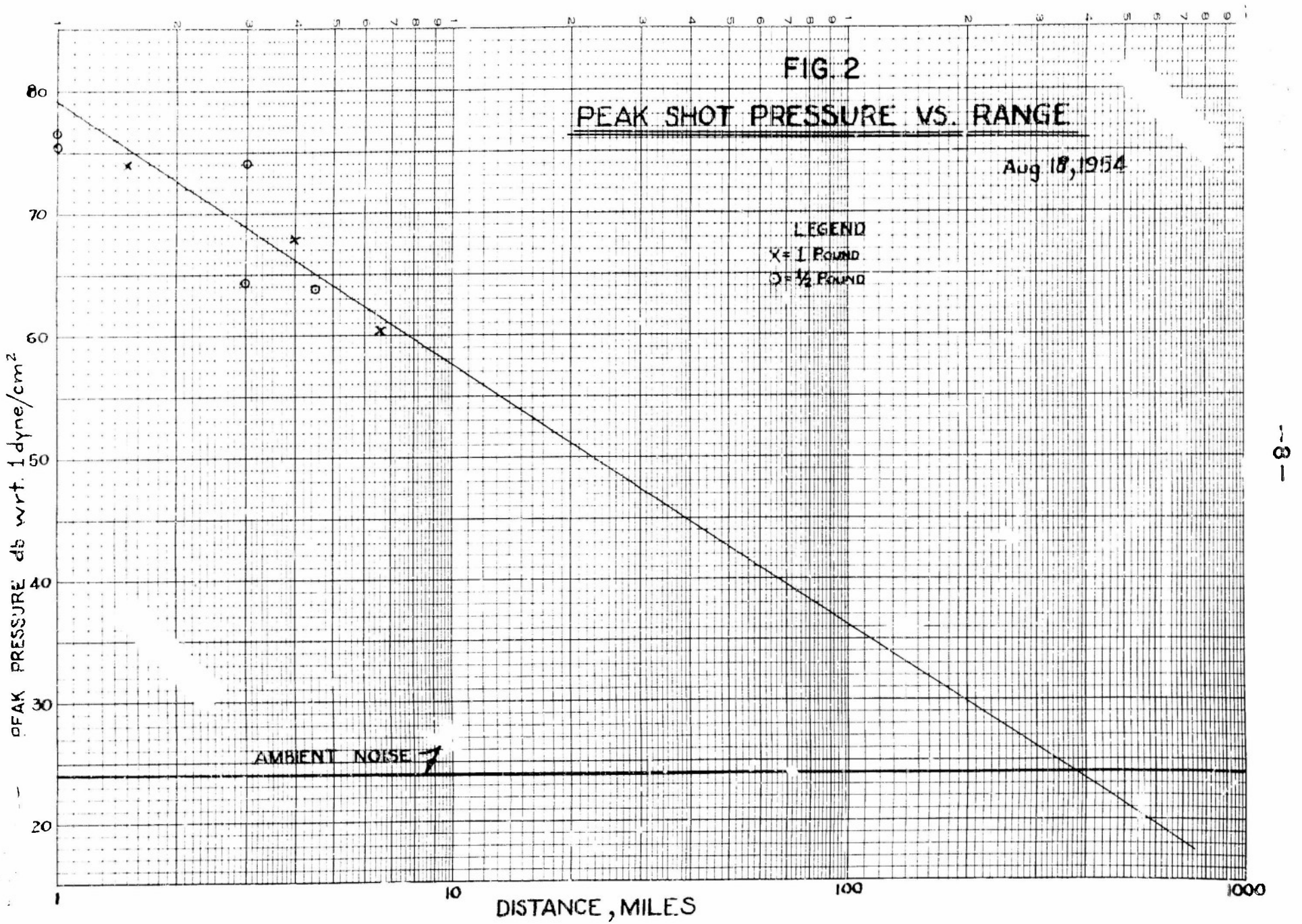
FIG. 2
PEAK SHOT PRESSURE VS. RANGE
Aug 18, 1954
LEGEND
X = 1 Pound
O = ½ Pound
AMBIENT NOISE
PEAK PRESSURE db wrt. 1 dyne/cm²
80
70
60
50
40
30
20
1
10
100
1000
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